B hadron decays and resonances at DØ

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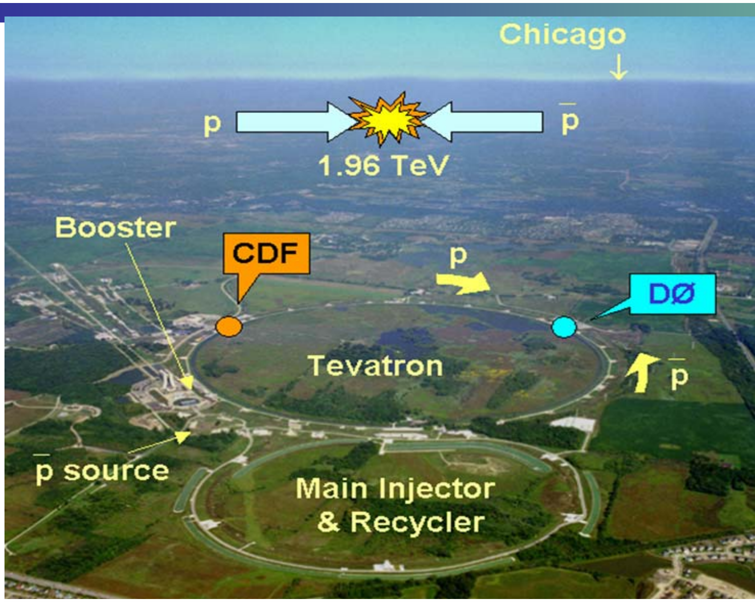
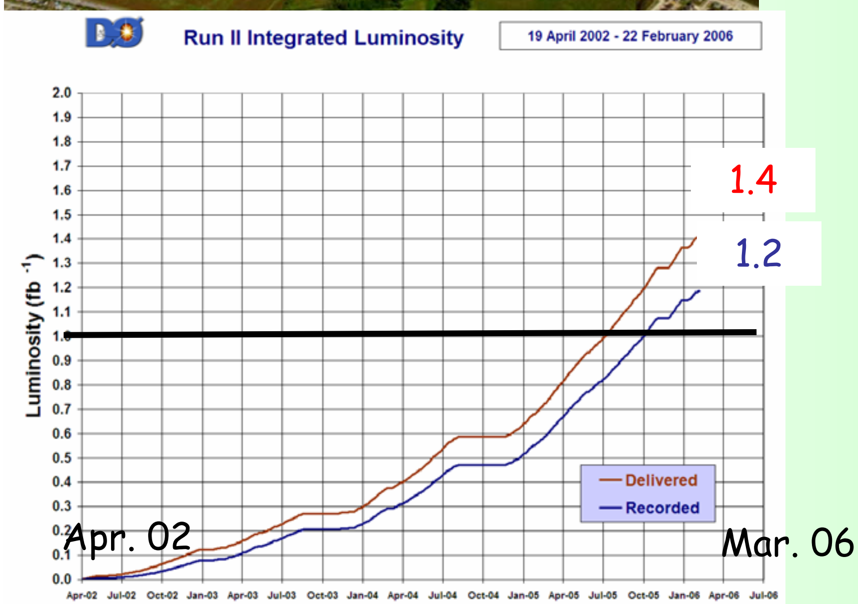
On behalf of the DØ Collaboration

Tevatron

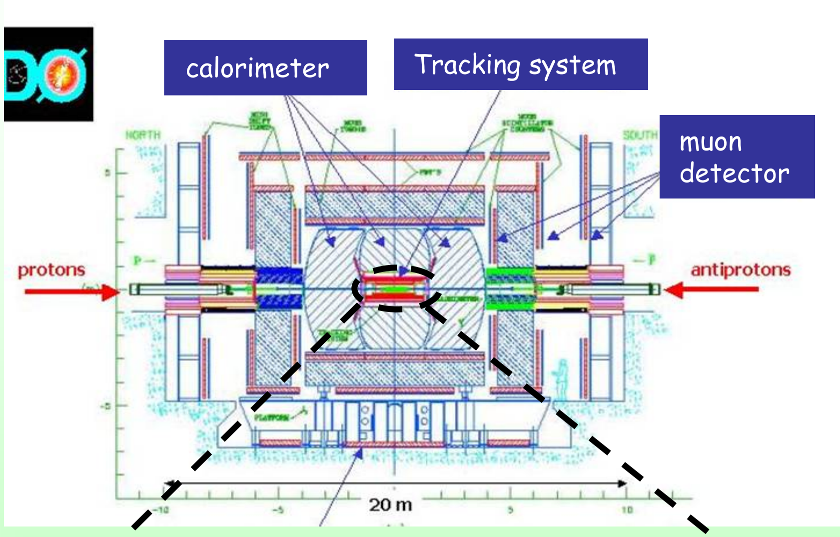


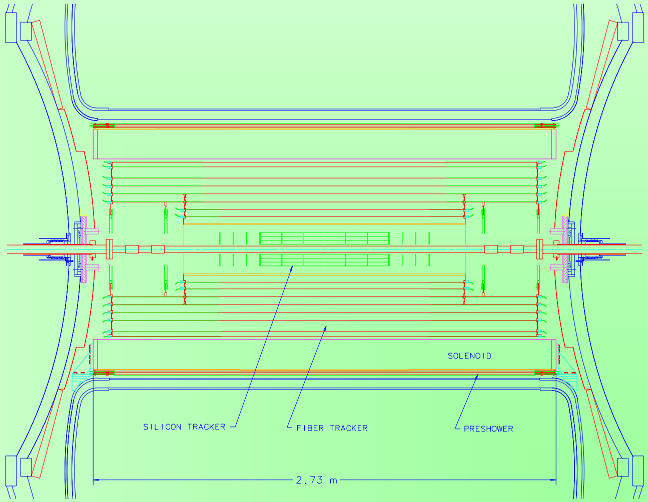


- Excellent performance of Tevatron in 2004 and 2005
- Highest luminosity delivered in D0 (January 06) : 1.6 10^{-32} $cm^{-2}s^{-1}$
- Machine delivered more than 1.4 fb^{-1}
- Recorded luminosity in DØ: 1.2 fb^{-1}
- High data taking efficiency ~ 85%
- Current datasets analyzed : up to 1 fb^{-1} (to be compared with ~ 100 pb^{-1} for Run I)
- With 2-3 $10^{-32}cm^{-2}s^{-1}$ expected
  $\rightarrow$ 2 fb^{-1} until 2006
  $\rightarrow$ 4-8 fb $^{-1}$ until 2009

The DØ detector

- Multipurpose detector dedicated to proton-antiproton collision @ 1.96 TeV
- Muon detector (central+forward) with good coverage ($|\eta|<2$). Single and dimuon robust triggers used in B physics analysis.
- Silicon and fiber tracker in 2T solenoid with coverage up to $|\eta|=3$.
  $\sigma(DCA) = 16\mu m$ @ $P_T = 10$ GeV
  innermost layer silicon detector being installed for RunIIb
- Calorimeter (EM+hadronic) used for electron flavor tagging.





B physics

+

- Large X-section (>10^4 times larger than B-factories)

- All B species produced ($B^\pm$,B_d,B_c,B_s,Λ_b,…)

-

Inelastic QCD background very important requiring efficient trigger and reliable tracking and vertexing

Large variety:

Production properties ($\sigma(b)$, $\sigma(J/\psi)$…
B branching ratios
Lifetimes ($\Delta\Gamma$, $B^\pm$, B_d, B_c, B_s, …)
Spectroscopy (B^*, B^{**})
Mass measurements (B_c,Λ_b, B_s,…)
Mixing (B_d, B_s)
Rare decay searches ($B \to \mu\mu$/ $\mu\mu\Phi$)
New particles X(3872), pentaquarks
New physics ?

Focus on spectroscopy, rare decays and lifetime new results (mainly with 1 fb^{-1} and Bs mesons).

B mesons spectroscopy (1)

Naming convention and motivation:

- (bd) quark system : $B_J = B_d^{**} = \{ B_1, B_2^* \}$
  (bs) quark system : $B_{sJ} = B_s^{**} = \{ B_{s1}, B_{s2}^* \}$
- Spectroscopy of B mesons is not well studied
- All previous results of the narrow L=1 states B_1 and B_2^* have been indirect and performed with low statistics and/or limited precision.
- Masses, widths and decay branching fractions of these states can be compared with theory (chiral quark model: hep-ph/01042208).

→ measure precisely the masses and production rates of B_J mesons, observe and measure mass of B_{sJ} state.

B mesons spectroscopy (2)

- Good qualitative understanding of B_0^*, B_1^*, B_1 and B_2^*. B_0^* and B_1^* decay through S-wave but large decay width → difficult to distinguish from phase space.
- B_1 and B_2^* decay through D-wave and should be narrow (~ 10 MeV)

→ search for B_J states decaying to $B^{+(*)}\pi$ with exclusively reconstructed B mesons:

$B_1 \rightarrow B^{+*}\pi^-$ (100%)

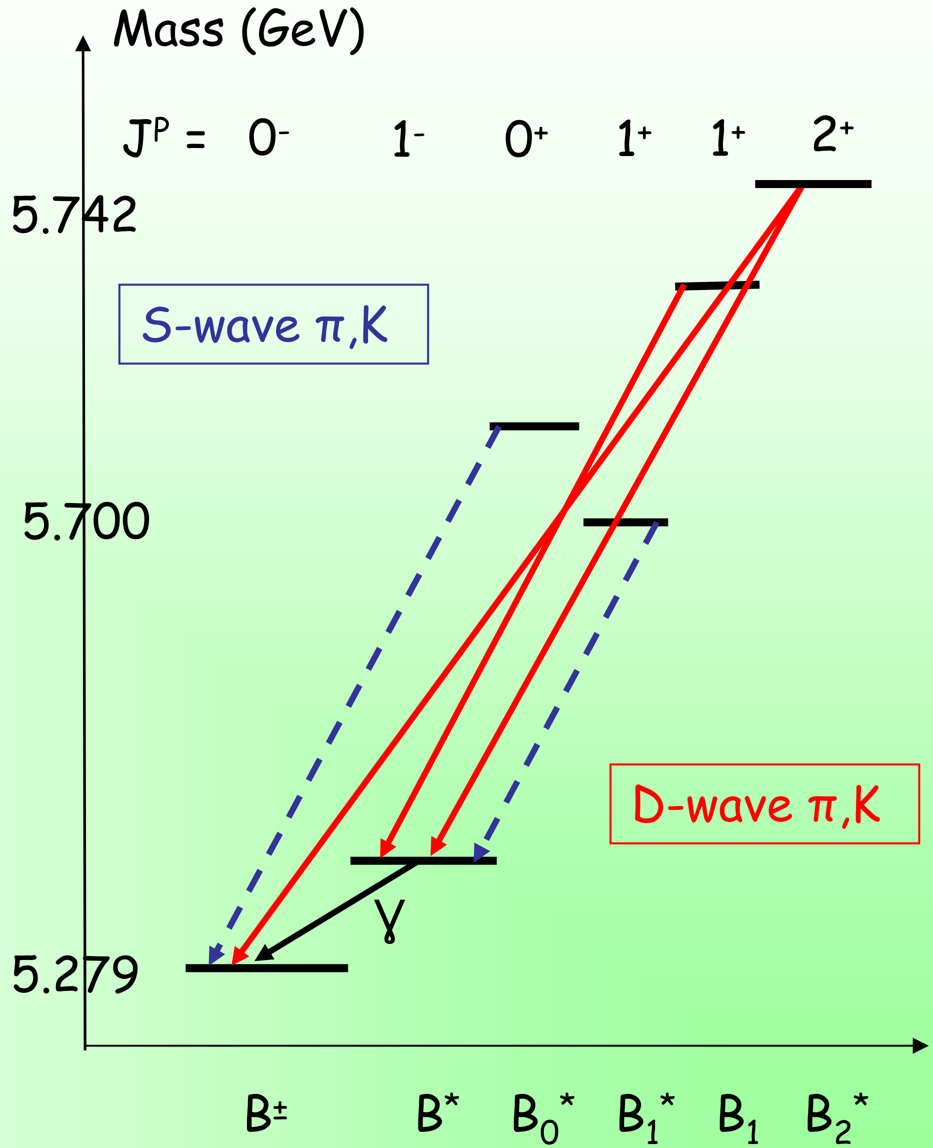
$B_2^* \rightarrow B^+\pi^-$ (50%)

$\rightarrow B^{*+}\pi^-$ (50%)

↳ $B^+\gamma$ (realease of an undetected photon of 45.78 ± 0.35 MeV)

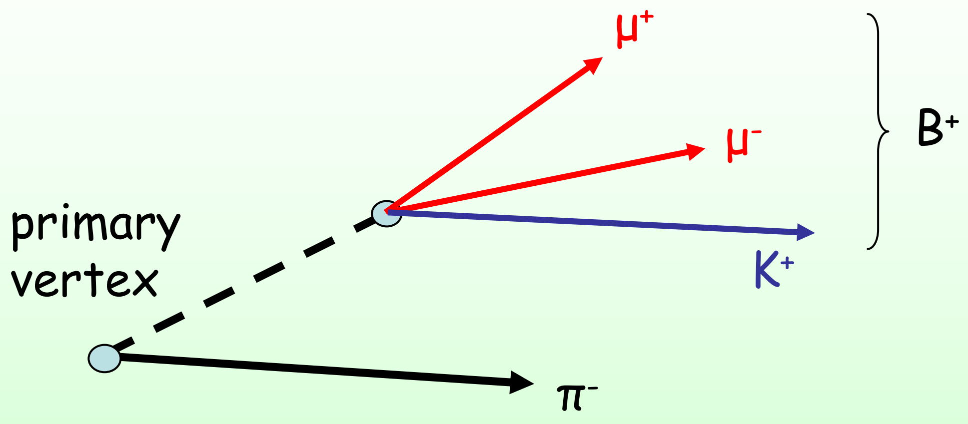
For B_{sJ} : $B_{sJ} \rightarrow B^{+(*)}K^-$

In both case, $B^+ \rightarrow J/\Psi K^+ \rightarrow \mu^+\mu^- K^+$

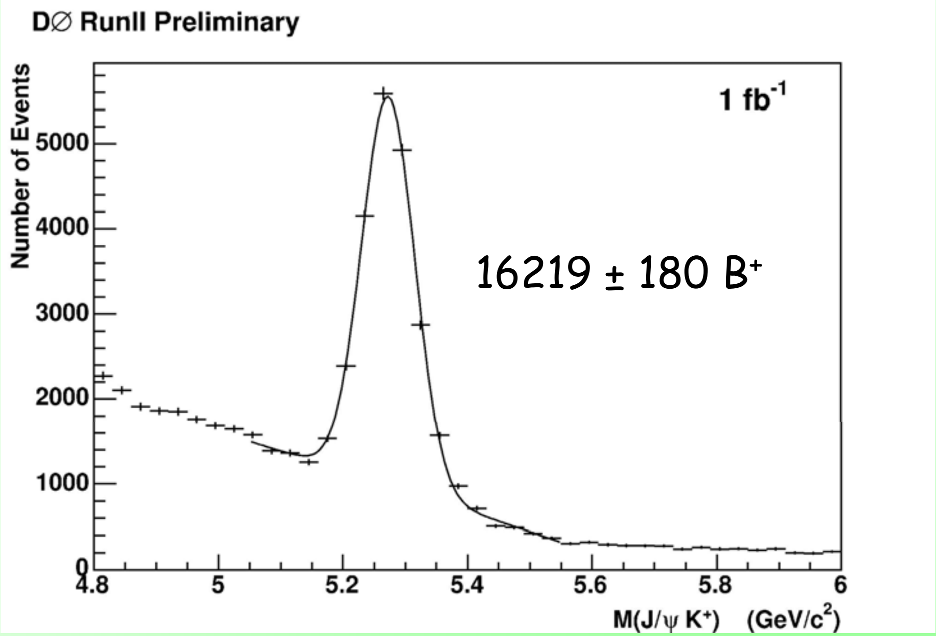


Analysis of B_J states: Reconstruction/Selection

Search for narrow states decaying to $B^+ \to J/\Psi\ K^+$ with $J/\Psi \to \mu^+\mu^-$



B+ selection:
Good B^+ vertex + kinematical cuts + likelihood ratio method



B_J selection:
For each B hadron, an additionnal track with

- $P_T > 0.75$ GeV
- Correct charge correlation ($B^+\pi^-$ or $B^-\pi^+$)
- Since B_J decays immediately after production track was required to originate from primary vertex.

Analysis of B_J states: ΔM results

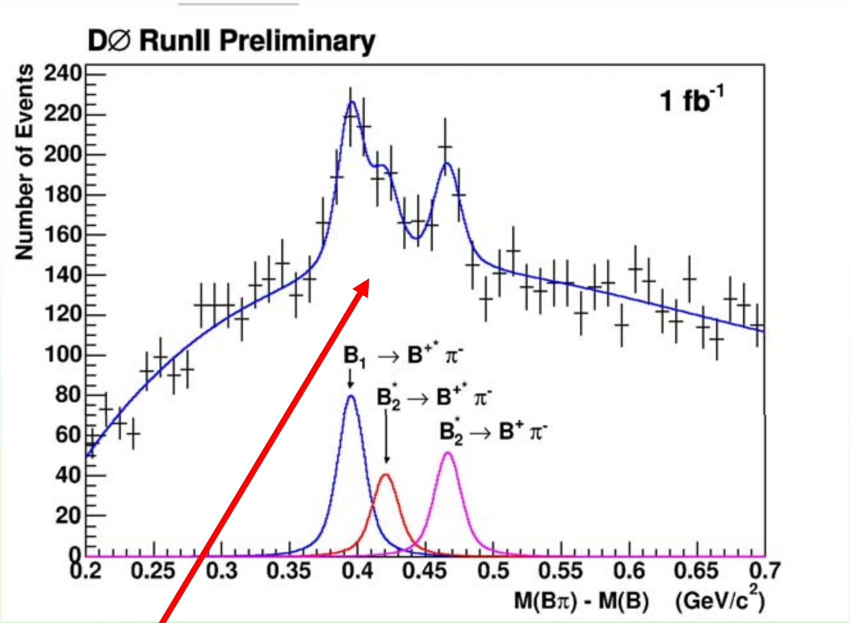
The distribution of the mass difference $\Delta M = M(B^+\pi^-) - M(B^+)$ can be interpreted in terms of B_J transitions.

- Fitting with

$$N\{ f_1 G(\Delta M,E_1,\Gamma_1) + (1-f_1)f_2\, G(\Delta M,E_2,\Gamma_2) + (1-f_1)(1-f_2)\, G(\Delta M,E_3,\Gamma_2) \} + F_{bkg}(\Delta M)$$

With

G : Convolution of a relativistic Breit-Wigner function with the experimental resolution on ΔM.



3 peak structure

Γ : mass width of the state (models predict Γ1 ~ Γ2 → Γ1 = Γ2 in the fit), E energy of the transition (ΔM)

f_1 : fraction of B_1 contained in the B_J sample, f_2 is the fraction of $B_2{}^* \to B^*\pi$ decay in $B_2{}^*$ signal.

Analysis of B_J states: final results

The B_1 and B_2^* are observed for the first time as two separate objects. Their masses and their average width were measured to be:

$M(B_1) = 5720.8 \pm 2.5\ (stat) \pm 5.3\ (sys)$ MeV

$M(B_2^*) - M(B_1) = 25.2 \pm 3.0\ (stat) \pm 1.1\ (sys)$ MeV

$\Gamma(B_1) = \Gamma(B_2^*) = 6.6 \pm 5.3\ (stat) \pm 4.2\ (sys)$ MeV

The branching ratio of B_2^* to the excited state B^* was measured as:

$Br(B_2^* \rightarrow B^* \pi)/Br(B_2^* \rightarrow B^{(*)} \pi) = 0.513 \pm 0.092\ (stat) \pm 0.115\ (sys)$

The fraction of the B_J sample in the state B_1 was measured as:

$Br(B_1 \rightarrow B^* \pi)/Br(B_J \rightarrow B^{(*)} \pi) = 0.545 \pm 0.064\ (stat) \pm 0.071\ (sys)$

The B_J production rate is measured as a fraction of B^+ rate:

$Br(b \rightarrow B^0{}_J \rightarrow B\ \pi)/Br(b \rightarrow B^+) = 0.165 \pm 0.024\ (stat) \pm 0.028\ (sys)$

Analysis of B_{sJ} states: B_{s2}^*

- Similary to B^{**} , chiral quark models predicts 2 wide (B_{s0}^* and B_{s1}^*) and 2 narrow (B_{s1} and B_{s2}^*) bound P-states in (bs) system.
- Due to isospin conservation, the decay to $B_s\pi$ is highly suppressed.
- Search for excited state decaying to B^+K^-

• Very similar to previous B_J search:

For each B hadron, an additionnal track:

$P_T > 0.6$ GeV

Charge opposite to charge of B^+

Track originate from primary vertex

Kaon mass assigned to the track

Analysis of B_{sJ} state : Results

Mass difference

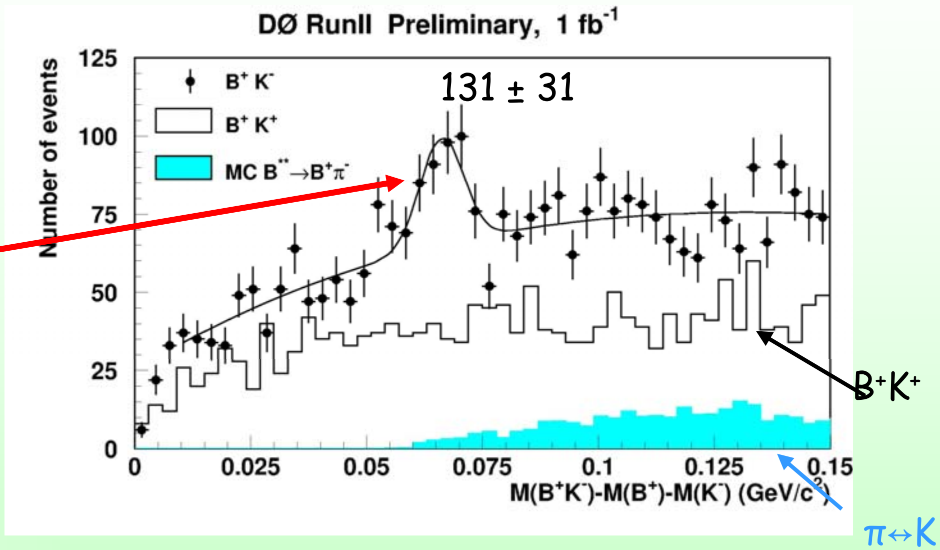
$\Delta M = M(B^+K^-) - M(B^+) - M(K^-)$

Significance of signal > 5

First direct observation of B_{s2}^*

Wrong charge sign correlations show no evidence of a peak

MC B_J decaying to $B^{(*)}\pi$ but reconstructed as B^+K^- show no evidence of a peak



$M(B_{s2}^*) = 5839.1 \pm 1.4(\text{stat}) \pm 1.5(\text{sys})$ MeV

The observed peak in the $B^+\pi^-$ distribution is interpreted as the decay:

$B_{s2}^* \to B^+K^-$ $\quad$ $M(BK) - M(B) = 66.4$ MeV

Note: $B_{s2}^* \to B^{*+}K^-$ decay predicted by theory would produce a signal at ~ 20 MeV strongly suppressed (small mass difference + suppression factor due to L=2). Absence of B_{s1} meson in ΔM: Theory predicts $M(B_2^*) - M(B_1) \approx 25.2$ MeV $\to$ B_{s1} decaying to $B^{*+}K^-$ is forbidden since $M(B_{s1}) < M(B^{*+}) + M(K^-)$

Searches for rare B_s decay

The decay $B_s \to \mu^+\mu^-$ is a FCNC process → forbidden in SM at tree level and proceeds through very low rate in higher order diagrams.

Ex: $Br_{SM}(B_s \to e^+e^-) = (8.15 \pm 1.29).10^{-14}$

$Br_{SM}(B_s \to \mu^+\mu^-) = (3.42 \pm 0.54).10^{-9}$

→ a signal would indicate new physics (SUSY, MSSM, etc…)

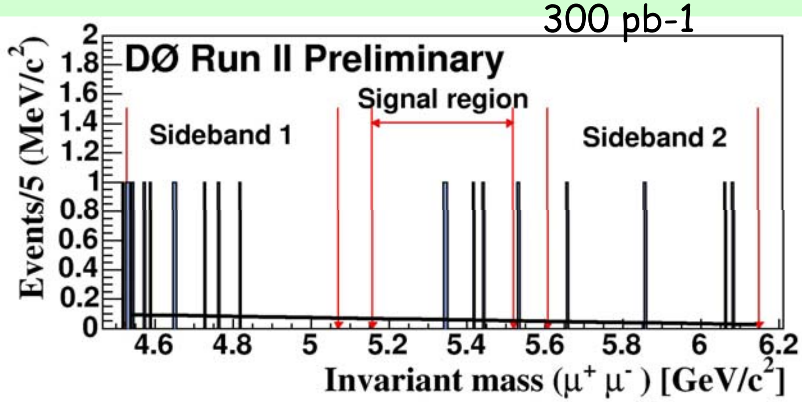
- "Blind" analysis with 300+400 pb^{-1} (secondary 3D-vertex built from two opposite charged tracks + discriminating variables (isolation of B_s, trans. decay length significance,…))
- Signal was optimized with random grid search
- 4.3±1.2 expected background events (for 300 pb^{-1})

  and 4 events found after selection

Calculate Br using the $B^+ \to J/\Psi K^+$ as normalisation channel

→ $Br(B_s \to \mu^+\mu^-) \leq 2.3(1.9).10^{-7}$ at 95(90)% CL for 700 pb^{-1}

300 pb-1



Another channel : $Br(Bs \to \mu+\mu- \Phi) \leq 4.1(3.2).10^{-6}$ at 95(90)% CL (assuming $Br(Bs \to J/\Psi\ \Phi) = 5.88 \pm 0.1$ %)) for 300pb^{-1}

B_s Lifetime

In the SM, the mass eigenstates of B_s mesons (B_s^H and B_s^L) are linear combinations of flavor eigenstates ($|B_s^0\rangle$ and $|B_s^0\rangle$):

$$| B_s^H\rangle = p\,|B_s^0\rangle - q\,|B_s^0\rangle \quad , | B_s^H\rangle = p\,|B_s^0\rangle + q\,|B_s^0\rangle \quad , p^2+q^2=1$$

and approximately CP eigentstates.

Def: $\Delta m = m_H - m_L$, $\Delta\Gamma = \Gamma_L - \Gamma_H$, $\Gamma = (\Gamma_L + \Gamma_H)/2$

B_s mesons are produced in an equal mixture of B_s^H and B_s^L and its decay length is described by:

$$\exp(-\Gamma_H t) + \exp(-\Gamma_L t) \quad \text{with } \Gamma_{L,H} = \Gamma \pm \Delta\Gamma/2$$

instead of $\exp(-\Gamma t)$ (assuming a single lifetime)

Analysis:

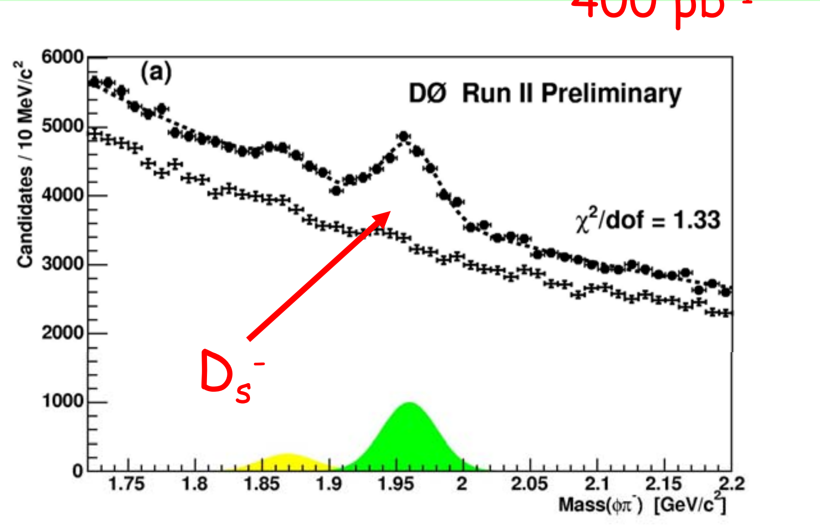
Reconstruction of semileptonic decay

$B_s \to D_s^- \mu^+ \nu X$, $D_s^- \to \Phi\pi^-$, $\Phi \to K^+K^-$

Good D_s vertex

+ kinematical cuts (P_T, mass, helicity angle) required

400 pb^{-1}

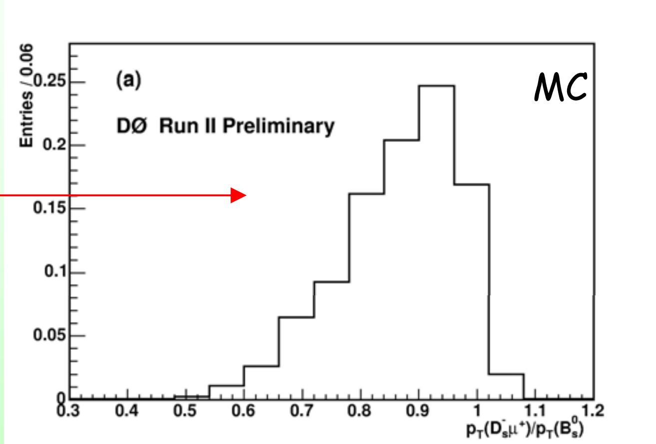


B_s Lifetime

- Combinatorial (from sideband D_s signal sample) + non-combinatorial (physical processes) background
- The pseudo-proper decay length is defined as:

$$PPDL = L_{xy}\, m(B_s)/P_T(D_s^- \mu^+)$$
$$= c\tau/K$$

K correction factor = $P_T(D_s^- \mu^+)\,/P_T(B_s)$
(accounts for ν/non-rec. charged particles)

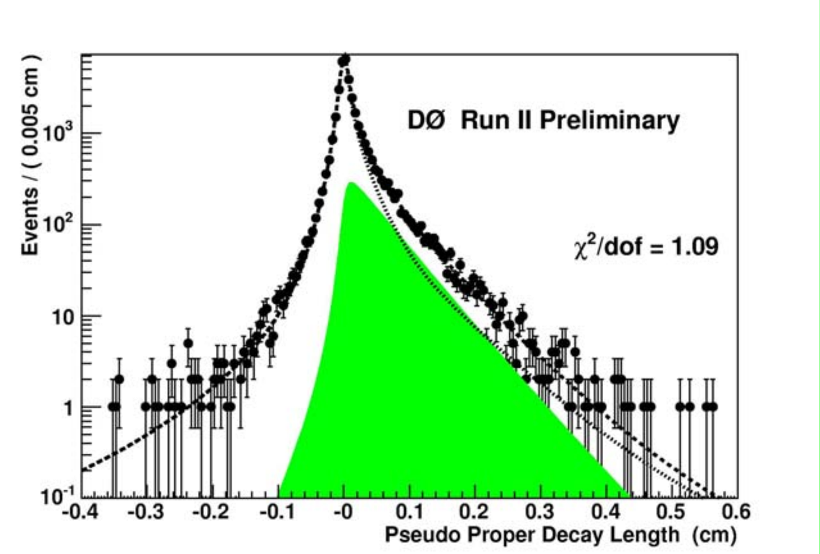


- The PPDL distribution is fitted using an unbinned maximum likelihood method (assuming single lifetime), 10 free parameters ($c\tau$, bkg description, scale factors)

PDF_{signal} = decay exp. $\otimes$ Gaussian res.
+ smearing with K factor
PDF_{bkg} = sum of bkg lifetime component $\otimes$ Gaussian res

$\tau(B_s^0) = 1.420 \pm 0.043(\text{stat}) \pm 0.057(\text{sys})$ ps

400 pb^{-1}



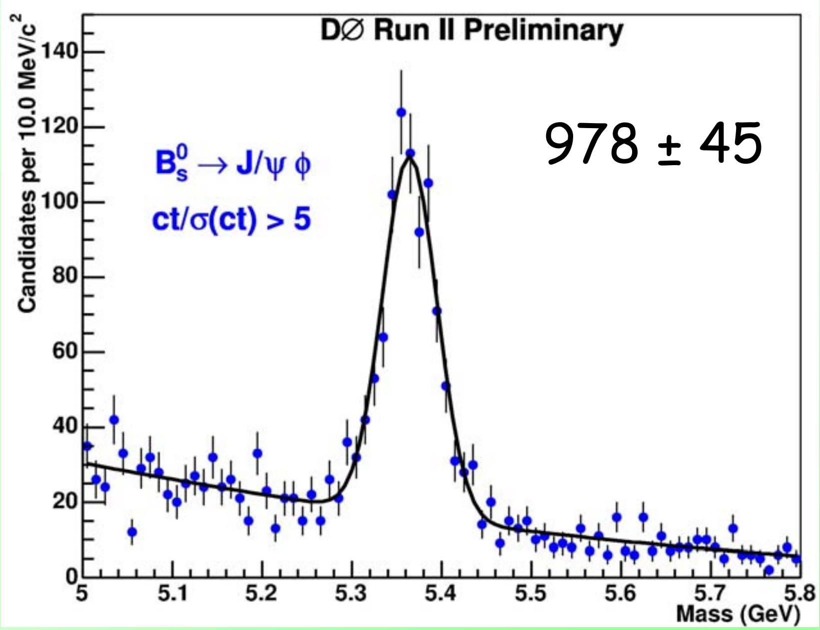
Analysis of $\Delta\Gamma$ (1)

- Study of the decay chain $B_s^0 \rightarrow J/\Psi\ \Phi$, $J/\Psi \rightarrow \mu^+\mu^-$, $\Phi \rightarrow K^+K^-$ giving rise to both CP = +1 and CP = -1 final states

$\rightarrow$ possibility to separate the 2 CP components and measure $\Delta\Gamma$ through simultaneous study of time evolution and angular decay products of J/Ψ and Φ.

- Analysis : selection and reconstruction of 0.8 fb^{-1}

- A simultaneous unbinned maximum likelihood fit to the B_s^0 candidate mass, PDL, and 3 decay angles describing the angular distribution of both J/Ψ and Φ final states in transversity basis.



Analysis of $\Delta\Gamma$ (2)

- Preliminary results (with 0.8 fb^{-1})

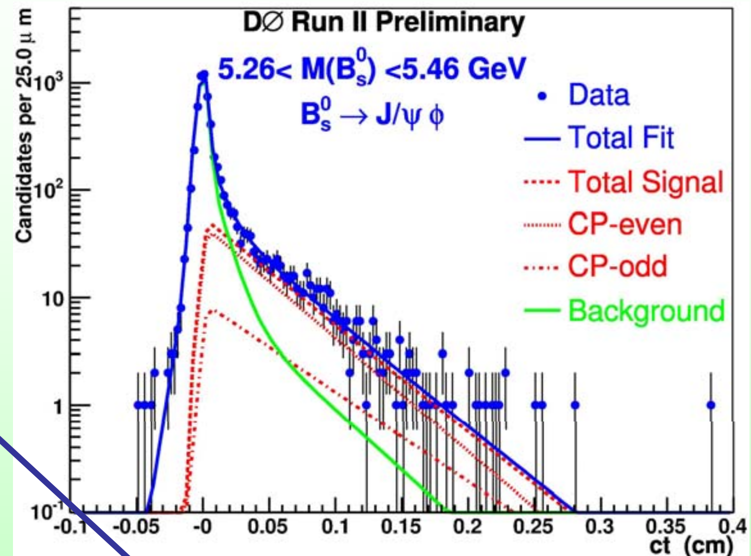
In the limit of NO CP violation:

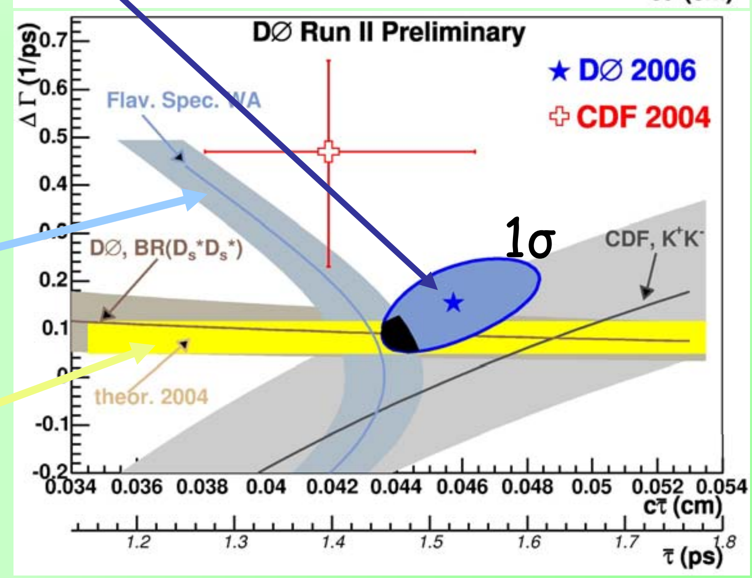
$\Delta\Gamma = 0.15 \pm 0.10 \pm {}^{0.03}_{0.04}$ ps^{-1}

$\bar{\tau}(B_s) = 1.53 \pm 0.08 \pm {}^{0.01}_{0.04}$ ps

$= 1.450 \pm 0.058$ ps ($\Delta\Gamma = 0$)

CP violating interference term is consistent with NO CP violation in the (B_s^0, $\overline{B_s^0}$) system. (statistical precision of the estimate of CP violating angle $\delta\Phi = -0.9 \pm 0.7$)





World average based on flavor specific decays

consistent with SM

theory

Conclusion

- B physics = large possibility of new measurements
- First results with 1 fb^{-1} in D0, very impressive
- Future is a gold mine for B physics

Back up slides

B_J and B_{sJ}: Theoretical predictions

	Eichten, Hill, Quigg FERMILAB-CONF-94/118-T	Di Pierro, Eichten Hep-ph/0104208	Ebert, Galkin Phys. Rev. D57, 5663, 1998	Orsland, Hogaasen, Eur. Phys. J. C9, 503,1999
$M(B_1)$ MeV $M(B_2^*)$ MeV	5759 5771	5714 5742	5719 5733	5623 5637
$M(B_{s1})$ MeV $M(B_{s2}^*)$ MeV	5849 5861	5820 5842	5831 5844	5718 5732

HQET

Relativistic quark model

MIT bag model

B_J states: B^+ selection in detail

- B^+ reconstructed in the exclusive decay $B^+ \rightarrow J/\Psi\ K^+$, $J/\Psi \rightarrow \mu\mu$:

Muons identified with standard muon identification tools

$Pt(\mu)>1.5$ GeV

Two muons should form a common vertex with mass >2.8 and <3.35 GeV

Additionnal charged track with Pt>0.5 GeV with kaon mass assignement

Good common vertex with the 2 muons (chisquare cut) displaced ($L/\sigma(L)>3$) w.r.t PV

Then B^+ is reconstructed from these 3 particles.

The reconstructed track associated to the B^+ should originate from the PV with a significance maxi cut.

Final B^+ selection is performed through a likelihood ratio method combining the following discrimanating variables:

Transverse momentum of the K

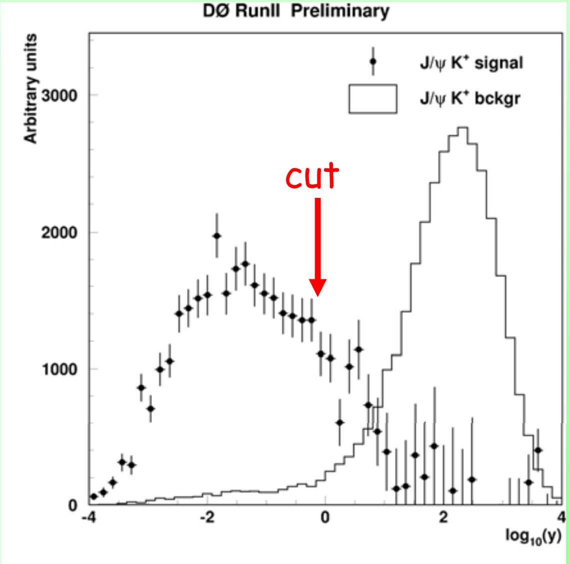
Minimal transverse momentum of the 2 muons

χ^2 of the B^+ decay vertex

B^+ decay length divided by its error

Significance of the B^+

Significance of the Kaon w.r.t the PV



B_J states: fitting detail

Following this expected pattern, the experimental distribution was fitted by the following function:

$$\begin{aligned} F(\Delta M) &= F_{sig}(\Delta M) + F_{back}(\Delta M) \\ F_{sig}(\Delta M) &= N \cdot (f_1 \cdot G(\Delta M, \Delta_1, \Gamma_1) + (1 - f_1) \cdot (f_2 \cdot G(\Delta M, \Delta_2, \Gamma_2) + (1 - f_2) \cdot G(\Delta M, \Delta_3, \Gamma_2))). \end{aligned} \quad (7)$$

In these equations, Γ_1 and Γ_2 are the widths of B_1 and B_2^*, f_1 is the fraction of B_1 contained in the B_J signal and f_2 is the fraction of $B_2^* \to B^*\pi$ decay in B_2^{*0} signal. The parameter N gives the total number of observed $B_J \to B^{+(*)}\pi$ decays. The background $F_{back}(\Delta M)$ was parameterized by a fourth-order polynomial.

The function $G(x, x_0, \Gamma)$ is the convolution of the relativistic Breit-Wigner function with the experimental resolution in ΔM (parameterized by the double Gaussian function calculated from simulation):

$$G(x, x_0, \Gamma_0) = \frac{1}{N_0} \int Res(\sigma_1, \sigma_2, x', x, S) \cdot \frac{x_0 \Gamma(x)}{(x'^2 - x_0^2)^2 + x_0^2 \Gamma^2(x)} dx' \quad (8)$$

$$Res(\sigma_1, \sigma_2, x, \hat{x}, S) = \frac{1}{\sqrt{2\pi}\sigma_1} \cdot \frac{1}{S+1} \exp\left(\frac{-(x-\hat{x})^2}{2\sigma_1^2}\right) + \frac{1}{\sqrt{2\pi}\sigma_2} \cdot \frac{S}{S+1} \exp\left(\frac{-(x-\hat{x})^2}{2\sigma_2^2}\right) \quad (9)$$

$$N_0 = \int \frac{x_0 \Gamma(x)}{(x^2 - x_0^2)^2 + x_0^2 \Gamma^2(x)} dx \quad (10)$$

$$\Gamma(x) = \Gamma_0 \frac{x_0}{x} \left(\frac{k}{k_0}\right)^{2L+1} F^{(L)}(k, k_0) \quad (L = 2) \quad (11)$$

$$F^{(2)}(k, k_0) = \frac{9 + 3(k_0 r)^2 + (k_0 r)^4}{9 + 3(kr)^2 + (kr)^4} \quad (12)$$

The variables k, k_0 in (11-12) are the magnitude of the pion three-momentum in the B_J rest frame when B_J has a four-momentum-square equal to x^2 and x_0^2 respectively, $F^{(2)}(k, k_0)$ is the Blatt-Weiskopf form factor for $L = 2$ decay [15] and $r = 5\ (\mathrm{GeV/c})^{-1}$ is a B hadron mass scale. The widths σ_1 and σ_2, and the scale parameter S, are fixed from the simulation.

All theoretical models predict that the widths Γ_1 and Γ_2 of B_1 and B_2^* are almost equal. Therefore, they were set to be equal in the fit: $\Gamma_1 = \Gamma_2 = \Gamma$. In addition, the mass difference of B^* and B^+ was fixed at the PDG value of

B_J states: systematic errors

TABLE III: Systematic uncertainties of relative B_J production rate

source	$d(B_J)$
Number of B_J events	0.023
Number of B^+ events	0.001
Momentum difference	0.007
Uncertainty in resolution	0.015
π reconstruction efficiency	0.004
Total	0.028

Major contributions:

- Background parametrization
- Fitting range
- Bin widths/position
- Γ free in the fit

B_{sJ} states: systematic errors

TABLE I: Systematic uncertainties in the B_{s2}^{*0} mass.

source	$\delta M(B_{s2}^{*0})$ (MeV/c^2)
Fitting Procedure	1.0
Cut on p_T of kaon	1.1
Momentum scale	0.1
Total	1.5

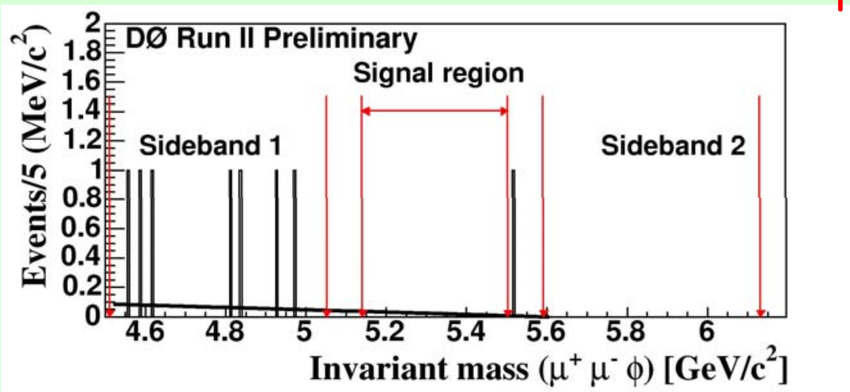
Searches for rare B_s decay (detail)

- Decay channel $B_s \rightarrow \mu^+\mu^-\Phi$ is also an exclusive FCNC decay.

  Within the SM, it can only occur through electroweak penguin and box diagrams (decay rate ~ 1.6 10^{-6})
- Analysis is very similar to the previous one, the Φ meson is reconstructed through its K^+K^- decay.
- Calculation of the branching fraction limit for $B_s \rightarrow \mu^+\mu^-\Phi$ is done by normalizing with the $B_s \rightarrow J/\Psi\ \Phi$ signal.
- 1.6 ± 0.4 expected background

  0 signal events

300 pb^{-1}



$\rightarrow$ $Br(B_s \rightarrow \mu^+\mu^- \Phi) \leq 4.1(3.2).10^{-6}$ at 95(90)% CL

(assuming $Br(B_s \rightarrow J/\Psi\ \Phi) = 5.88 \pm 0.1$ %))

Expected upper limit for rare B decays

Calculation of the sensitivity (= expected uppper limit on the Br):
Assuming N_{back} background events, we calculate for each possible value of observations N_{obs} a 95% CL upper limit $\mu(N_{obs}, N_{back})$. The average upper limit on the signal events is obtained by weighting each limit from the hypothetical ensemble by its poisson probability of occurrence:

$$\langle \mu(n_{back}) \rangle = \sum_{n_{obs}=0}^{\infty} \mu(n_{obs}, n_{back}) \cdot \frac{(n_{back})^{n_{obs}}}{(n_{obs})!} \exp(-n_{back}).$$

To translate this into a 95% CL upper limit on the Br, the number of $B^{\pm} \rightarrow J/\Psi(\mu\mu)K^{\pm}$ has been used as normalization, then:

$$\langle \mathcal{B}(B_s^0) \rangle \cdot \left(1 + R \cdot \frac{\epsilon_{\mu\mu}^{B_d^0}}{\epsilon_{\mu\mu}^{B_s^0}} \cdot \frac{b \rightarrow B_d^0}{b \rightarrow B_s^0} \right) =$$

$$\frac{\langle \mu(n_{back}) \rangle}{N_{B^{\pm}}} \cdot \frac{\epsilon_{\mu\mu K}}{\epsilon_{\mu\mu}^{B_s^0}} \cdot \frac{b \rightarrow B^{\pm}}{b \rightarrow B_s^0} \cdot \mathcal{B}(B^{\pm} \rightarrow J/\psi K^{\pm}) \cdot \mathcal{B}(J/\psi \rightarrow \mu\mu)$$

B_s lifetime: fitting in detail

Background probability density function, defined for each measured PPDL:

$$\begin{aligned}\mathcal{F}^j_{bg}(\lambda_j,\sigma(\lambda_j)) &= (1-f_+-f_{++}-f_-)G(\lambda_j,\sigma(\lambda_j)) \\ &+ f_+\frac{e^{-\lambda_j/\lambda^+}}{\lambda^+}+f_{++}\frac{e^{-\lambda_j/\lambda^{++}}}{\lambda^{++}} \qquad (\lambda_j\geq 0) \\ &+ f_-\frac{e^{\lambda_j/\lambda^-}}{\lambda^-} \qquad (\lambda_j<0),\end{aligned}$$

f fractions of events in the exponential decays with positive-long, positive-short, negative-long, negative-short PPDL. λ : slope of exponential decays.
Signal probability distribution function:

$$\mathcal{F}^j_{sig}(\lambda_j,\sigma(\lambda_j),s_1) = \int dK\ \mathcal{H}(K)\ \left[\frac{K}{c\tau(B^0_s)}e^{-K\lambda_j/c\tau(B^0_s)}\otimes\mathcal{G}(\lambda_j,\sigma(\lambda_j),s_1)\right],$$

Analysis of ΔΓ/Γ : signal parametrization

In transversity basis:

$$\frac{d^3\Gamma(t)}{d\cos\theta\ d\varphi\ d\cos\psi} \propto\ 2|A_0(0)|^2 e^{-\Gamma_L t}\cos^2\psi(1-\sin^2\theta\cos^2\varphi)$$

$$+\sin^2\psi\{|A_{\|}(0)|^2 e^{-\Gamma_L t}(1-\sin^2\theta\sin^2\varphi)+|A_{\perp}(0)|^2 e^{-\Gamma_H t}\sin^2\theta\}$$

$$+\frac{1}{\sqrt{2}}\sin 2\psi|A_0(0)||A_{\|}(0)|\cos(\delta_2-\delta_1)e^{-\Gamma_L t}\sin^2\theta\sin 2\varphi$$

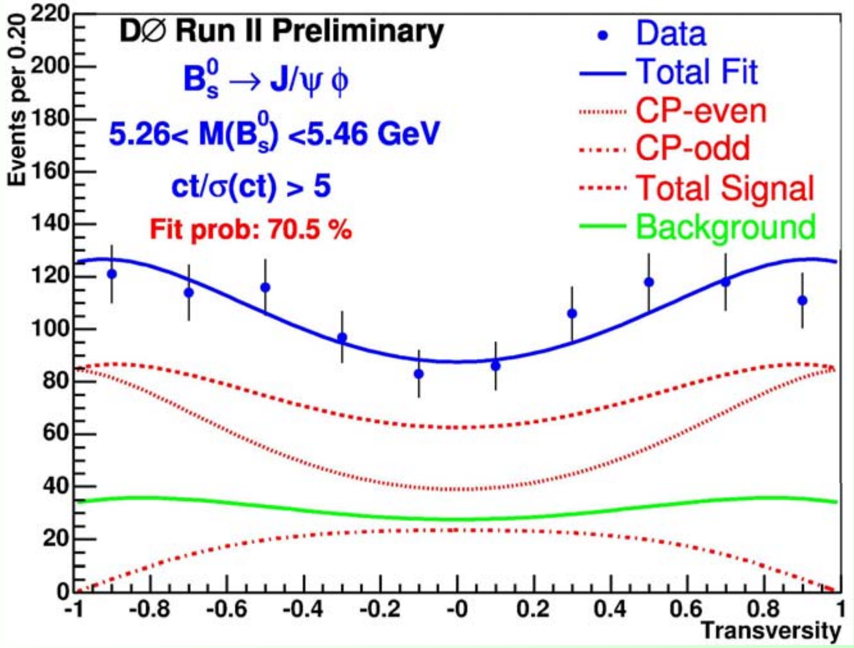
$$+\left\{\frac{1}{\sqrt{2}}|A_0(0)||A_{\perp}(0)|\cos\delta_2\sin 2\psi\sin 2\theta\cos\varphi\right.$$

$$\left.-|A_{\|}(0)||A_{\perp}(0)|\cos\delta_1\sin^2\psi\sin 2\theta\sin\varphi\right\}\frac{1}{2}\left(e^{-\Gamma_H t}-e^{-\Gamma_L t}\right)\delta\phi\ .$$

In the J/Ψ restframe, transversity polar and azimuthal angles (θ,φ) describes direction of the μ^+, and Ψ is the angle between the K^+ direction and –J/Ψ direction in the Φ meson rest frame. The quantity δΦ (about 0.03 in the SM) is a CP-violating weak phase due to interference effects between mixing and decay.

Analysis of $\Delta\Gamma/\Gamma$: Transversity angle

Transversity angle from the fit projection:



0.8 fb^{-1}

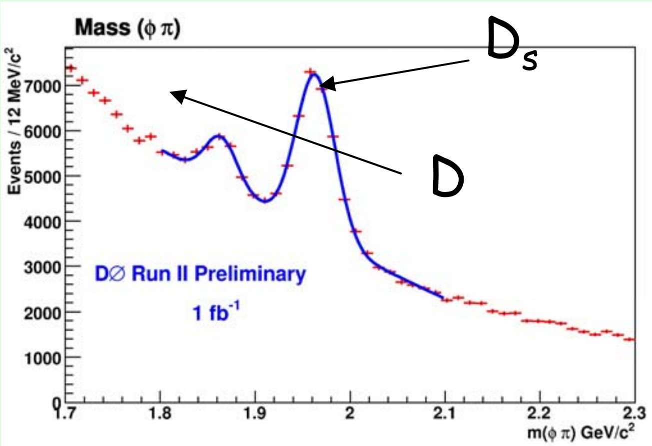
Measurement of $Br(B_s^0 \to D_s^{(*)} D_s^{(*)})$

- Motivation : $B_s^0 \to D_s^{(*)} D_s^{(*)}$) decay predominantly CP even and

$$2Br(B_s^0 \to D_s^{(*)} D_s^{(*)}) \approx \frac{\Delta\Gamma}{\Gamma\cos\phi}(1+O(\frac{\Delta\Gamma}{\Gamma}))$$

where $D_s^{(*)}$ = $\{D_s, D_s^*\}$, one $D_s \to \Phi\pi$ and the other $D_s \to \Phi\pi\mu$.
Selection of a μD_s sample with $D_s \to \Phi\pi$ and with an additionnal Φ meson $\to \mu\Phi D_s$ sample:
Using an unbinned likelihood fit and an estimate of background (combinatorial + physical processes) D0 derives the number of signal events:

$N(\mu D_s) = 15225 \pm 310$ and $N(\mu\Phi D_s) = 19.34 \pm 7.85$



From the knowledge of $Br(D_s \to \Phi\mu V)$, $Br(B_s^0 \to \mu V D_s^{(*)})$, the new Babar $Br(D_s \to \Phi\pi)$ and a ratio of efficiencies , one obtains:

$Br(B_s^0 \to D_s^{(*)} D_s^{(*)}) = 0.071 \pm 0.035(stat)\ ^{+0.029}_{-0.025}\ (sys)$

Then : $\Delta\Gamma_{CP}/\Gamma\ (B_s^0) = 0.142 \pm 0.064(stat)\ ^{+0.058}_{-0.050}\ (sys)$